

REMARKS

Claims 1, 2, 4-7, 9, 11-17, 19-22 and 24-35 are pending in this Application. By this Amendment, Claims 1, 5, 11, 12, 21, 22, 24-26, 28 and 29 are amended and new Claims 30-35 are added. Support for new Claims 30-35 can be found in the original specification, for example, see pages 12 and 13 for Claim 30, pages 12 and 14 for Claim 31, page 4 for Claim 32, page 11 for Claim 33, page 4 for Claim 34 and page 10 for Claim 35. Reconsideration in view of the above amendments and following remarks is respectfully requested.

Applicants note that Claim 16 was not rejected in the Office Action dated June 9, 2004. As such, Applicants submit that Claim 16 is allowable.

Applicants gratefully acknowledge the courtesies extended by Examiners Maldonado and Fourson on September 10, 2004 in a personal interview. In the interview, Kadomura (U.S. Patent No. 4,654,114), Long et al. (U.S. Patent Publication No. 2003/0079983 A1, hereinafter "Long") and Hung et al. (U.S. Patent No. 6,380,096 B2, hereinafter "Hung") were each discussed alone and in combination with one another. The substance of the interview is incorporated in the discussion below.

In the interview, the Kadomura reference was discussed, wherein Applicants' representative pointed out to the Examiners that in the description of the preferred embodiments of Kadomura, CH_2F_2 is the preferred etchant gas material. Further, that CO_2 is mentioned throughout the description of the preferred embodiments, whereas O_2 is not disclosed within the description of the preferred embodiments. In response, the Examiners pointed out that in Kadomura column 3, lines 19-42, CO_2 and O_2 are discussed. However, Applicants' representative explained that according

to Kadomura column 3, lines 37-42, Kadomura uses O₂ with CHF₃ in a discussion of the prior art.

Furthermore, in the interview, Applicants' representative discussed the Long reference, wherein the Long reference merely discloses controlling the uniformity of plasma in a capacitively coupled plasma source by differing at least one of power, frequency, phase, and waveform from the RF power coupled via a sub-electrode. See Long Abstract.

Further, with respect to the Hung reference, in the interview the Applicants' representative discussed the fact that the Hung reference only discloses a high-density plasma reactor and does not disclose or suggest a parallel plasma reactor or a capacitively coupled plasma source, while Kadomura and Long do not disclose using a high density plasma reactor.

Therefore, Applicants respectfully submit that all claims are allowable over the references of record for the reasons discussed in the interview, as well as the above amendments and following remarks.

The Office Action objects to Claims 1 and 24 stating that "the claims do not require a particular plasma density through use of 'medium density plasma' because the term does not have an accepted meaning in the art and has not been defined in the instant specification." See the Office Action, page 2. Although Applicants do not acquiesce in the objection, the objection is moot in view of the deletion of "medium density in claims 1 and 24.

The Office Action rejects Claims 1, 2, 4, 6, 7, 11-15, 19-22, 24 and 27-29 under 35 USC § 103(a) over "Applicants Admitted Prior Art" (hereinafter "AAPA") in

view of Kadomura and Long. Since the references, alone or in combination, fail to disclose or suggest all the features of the claims, the rejection is traversed.

Claim 1, as amended, recites a process for etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer, which comprises, *inter alia*, "supplying etching gas to the plasma etching reactor and energizing the etching gas into a plasma state, the etching gas including CH₃F and O₂ supplied to the plasma etching reactor at a flow rate ratio of O₂ to CH₃F of 0.65 to 1.5" (emphasis added).

Similarly, Claim 24, as amended, recites a process for etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer, which comprises, *inter alia*, "supplying etching gas etching gas to the plasma etching reactor through the showerhead electrode and energizing the etching gas into a plasma state in a gap between the showerhead electrode and the bottom electrode, the etching gas including CH₃F and O₂ supplied to the plasma etching reactor at a flow rate ratio of O₂ to CH₃F of 0.65 to 1.5" (emphasis added).

Additionally, Claim 29, as amended, recites a process for etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer, which comprises, *inter alia*, "supplying etching gas to the plasma etching reactor through the showerhead electrode and energizing the etching gas into a plasma state in a gap between the showerhead electrode and the bottom electrode, the etching gas including CH₃F and O₂ supplied to the plasma etching reactor" (emphasis added).

It is asserted in the Office Action on page 3 that:

[t]he prior art fails to teach etching the silicon nitride layer using a parallel plate plasma reactor; supplying etching gas to the plasma etching reactor and energizing the etching gas into a plasma state, the etching gas including CH₃F and at least one oxygen reactant

supplied to the plasma etching reactor at a flow rate ratio of oxygen reactant to CH_3F of 0.65 to 1.5; and etching exposed portion of the silicon nitride layer with the plasma while providing an etch rate selectivity the etching rate of the silicon nitride layer to the etching rate of the dielectric layer of at least about 10.

It is also asserted in the Office Action that Kadomura "teaches ... supplying etching gas ..., the etching gas including CH_3F and at least one oxygen reactant."

See page 3 of the Office Action.

A. Kadomura Teaches Away from Supplying an Etching Gas Including CH_3F and O_2

Applicants disagree with this assertion and submit that Kadomura fails to disclose or suggest the combination of features recited in Claims 1, 24 and 29 which include at least the feature of supplying an etching gas including CH_3F and O_2 and teaches away from the use of an etching gas including CH_3F and O_2 to etch a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer as recited in Claims 1, 24 and 29.

As discussed in the interview and as discussed above, in contrast to the claimed method, Kadomura does not disclose or suggest an etching gas including CH_3F and O_2 supplied to the plasma etching reactor. Instead, Kadomura discloses that a gas mixture composed of a fluorocarbon gas (such as CH_2F_2) and CO_2 can be used to etch a Si_xN_y layer with selectivity to a SiO_x layer (see col. 2, lines 16-30). In other words, Kadomura adds oxygen to obtain faster etching of silicon nitride compared to silicon oxide. Thus, Kadomura teaches away from using an oxygen containing gas to etch a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer as recited in Claims 1, 24 and 29.

Long fails to cure the deficiencies of AAPA and Kadomura. The Office Action asserts that Long “[teaches] a capacitively coupled plasma etching reactor comprising a dual frequency parallel plate plasma reactor ...” but does not assert that Long teaches or discloses supplying an etching gas including CH₃F and O₂.

B. The Office Action Admits that AAPA, Kadomura and Long Fail to Teach an Etching Gas with CH₃F and Oxygen

Additionally, on page 8 of the Office Action it is asserted that “[t]he combined teachings of the prior art, Kadomura and Long et al ... fail to teach wherein the etching gas consists of CH₃F, oxygen and optionally Ar” (emphasis added).

For at least the reasons set forth above, Applicants respectfully submit that Claims 1, 24 and 29 are allowable. Claims 2, 4, 6, 7, 11-15 and 19-22 depend from Claim 1 and Claims 27-28 depend from Claim 24, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

The Office Action rejects Claims 5, 9, 25 and 26 under 35 USC § 103(a) over AAPA in view of Kadomura and Long and in further view of Hung. Since the references, alone or in combination, fail to disclose or suggest all the features of the claims, the rejection is traversed.

It is asserted in the Office Action on page 8 that “Hung et al. (Figs.5-10) in a related method to selectively plasma etch a silicon nitride layer (12, 16) teach an etching gas [consisting] of CH₃F, oxygen and optionally Ar” (emphasis added). It is also asserted in the Office Action on page 9 that:

one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed etching step of Kadomura and Long et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

C. Hung Cannot Be Combined with Kadomura and/or Long

Hung discloses a high-density plasma reactor, as such, Hung cannot be combined with Kadomura and/or Long. Applicants respectfully submit that Kadomura discloses a parallel plate type RIE apparatus, which does not provide a high density plasma and Long discloses a capacitively coupled plasma source, which also does not provide a high density plasma. Therefore, Applicants submit that Hung's high-density plasma reactor is unsuitable for use with Kadomura and/or Long, thus it would not have been obvious to a person of ordinary skill in the art to modify Kadomura and Long as suggested in the Office Action.

Additionally, as Hung is merely cited in reference to dependent claims, Applicants submit that Claims 5, 9, 25 and 26 are allowable for at least the same reasons as the independent claims from which they depend.

For at least the reasons set forth above with respect to Claim 1 from which Claims 5 and 9 depend from and Claim 24 from which Claims 25 and 26 depend from, Applicants respectfully submit that AAPA, Kadomura and Long, alone or in combination, fail to disclose or suggest the combination of features recited in Claims 1 and 24. Withdrawal of the rejection is respectfully requested.

Applicants respectfully submit that new Claims 30-35 are allowable over the cited references for at least the same reasons as discussed above with respect to Claim 29 from which Claims 30-35 depend.

CONCLUSION

From the foregoing, further and favorable action in the form of a Notice of Allowance is earnestly solicited. Should the Examiner feel that any issues remain, it

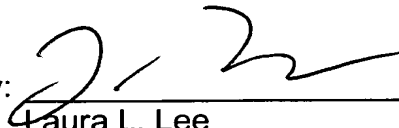
is requested that the undersigned be contacted so that any such issues may be adequately addressed and prosecution of the instant application expedited.

Respectfully submitted,

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